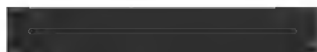


SINCLAIR ZX 8K ROM* UPGRADE

Thomas J. Bent



* Use of the 8K operating system has been granted by Sinclair Research, thereby allowing this upgrade to be possible. I am grateful for their generosity.

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Dear Sinclair Enthusiast,

Here is the eprom upgrade for your operating system. Version 10. is the current issue. Several revisions have been made to both "fix" and improve the Sinclair BASIC operating system. I'm quite sure that all of the changes will delight you. You will probably forget that it is installed in a few short days. ALL of the software that would run before will still run, but you must have at least 16K RAM. The machine will initialize with 1 or 2K RAM, because of the partial decoding in the machine. Programs will not run though.

There are a few key changes that will remind you that you have indeed upgraded. The single most noticeable change is the automatic FAST edit. Now, whenever you enter an empty cursor, or key in a program line, the computer will jump into FAST mode and stay there until you input SLOW again. If your program requires SLOW mode to work properly, then remember to input SLOW in the direct mode before RUNning it. This alleviates that annoying "rolling screen" that can't decide which line should be listed first.

The second major change is the FAST initialization. Although the computer still only initializes 16K on power up, even a 64K NEW (POKE 16388,255 POKE 16389,255) will give a K cursor in the lower left corner in about 2 seconds. This routine will not adjust for your LACK of ram. If you only have 16K of ram, then don't poke ramtop up to 64K. I guarantee a crash. To run properly in 2K, POKE 16389,72 and NEW.

The Load routine has been changed slightly also. Before, if you had a bad load, the computer would jump into the middle of the initialization routine and reset the display file and stack pointers, but would leave clutter in memory (not really a problem) and not reset all of the operating system variables. Now, it jumps to the beginning of the NEW command and properly resets everything below RAMTOP. (RAMTOP is still a safe byte. NEW does not affect it.)

The CLS routine has been shortened and modified so as to not collapse the display file anymore. Before, everytime you enter a BASIC line the computer would check to see if you had enough memory to create a machine stack and steal memory from the display file if needed. Then, after computation, the display would have to be regenerated. As you pushed the limits of your memory, you stood a good chance of crashing because of all the stack manipulation. Now, the computer won't take a line unless it can handle it properly. As you approach the limit of your memory you will find that the computer will not take a line with a number, although it will take other lines. There just isn't enough room to compute those big floating point numbers. Try the following listing on a 2K machine to see what I mean:

In the direct mode, DIM A(10)

```
1 REM
10 PRINT
20 PRINT 10
```

The problem of letting the display file overlap the 32K mark still exists, so if you have 64K beware! This problem exists because of the way that the Sinclair handles address line A15 (it is used as a sort of memory map line for the display). If you encroach on address 32768, you crash.

With a fixed size display file, another change is possible. SCROLL is now a very useful (and fast) routine. Before, if you scrolled your screen 22 times and then CLS, you could practically take a nap waiting to regain control of your Sinclair. Not anymore! Now, Flight Simulator acts properly after a crash (literally of course).

As a sideline to having a fixed display file, all those ROM checks to see if the display location is available fall through immediately, thereby slightly speeding up the print routines, such as, TAB and AT.

Do you use a large database? Now you can DIMension large single arrays up to 47872 (BB00h). If you have a monitor program in the 8-16K block and need no BASIC lines, then you can go just over 48000 (BBFFh) with your array. You can't make an array too large for your memory though. You will get a very thoughtful error 4.

Two bugs that have been squished (in the TS1500 also) are the LPRINT and divide bugs. The divide bug is a problem when doing repetitive math work, such as matrix inversion, simultaneous equations, TAN (the computer generates the TAN function by calculating SIN/COS), etc. If you do this type of work, you can notice a reduction in the sum of the squares calculations (see more info on this in SWN vol 1). For an interesting demonstration of this bug, run the short test listing before you put in the new eprom, and put the print line inside the loop (it won't run very long). This will answer the question; "how much is one bit?"

The other obvious bug is the LPRINT bug. This annoying creature sneaks up on you and prints garbage on your printer regardless of the interface or printer that you are using. This one got by Sinclair Research because there was no printer available when they finalized the last issue of the ROM. (Don't you just love aftermarket support!) The problem occurs when you try to print variable numbers less than 0.1 and greater than 1E-5. All of the leading zeroes come out as trash. To get around this problem you have had to convert your numbers to strings and LPRINT the strings. If you LET X = .0001, and then LPRINT X, you will see what I mean. This is no longer a problem.

A few cosmetic changes have made in the character generator also. Because the display on your TV is probably not the best in the world, we have changed some of the bit patterns in order to improve the readability of a few of the characters. The Q, W, V, K and British Pound sign have been modified. The most noticeable change is the pound sign, which is now an apostrophe. Now, the Q, O and 0 are all distinct; and the indeterminate W, U and V are well defined. They will all print that way on the 2040 and ZX printer too. Although the bit patterns are in the eprom, not all of the characters are available to change. If you look in the appendix of your instruction manual, only the first 64 characters are at your disposal (up to Z). The rest of the graphics, inverse characters, tokens and composite characters (" and **) are created by the Sinclair logic chip and the token tables in the ROM. However, any of the first 64 characters can be changed (by further changing the eprom).

The last and most unique change that has been made to date is the modified LPRINT command. This command is transparent until you invoke it. This routine is called by RANDing an address in memory that you want to go to, POKE'ing 16393,1 (VERSN, which is the first byte saved in your program) and LPRINT'ing. For example:

```
10 RAND xxxxx (any address at which you have a working machine code
subroutine: end with RET)
20 POKE 16393,1 (or any odd number)
30 LPRINT (or LPRINT X, LPRINT "HELLO")
```

This is very similar to USR, except that LPRINT has syntax checking and has the power to easily pass variables or text to your routines without a lot of overhead or searching for your data. It can also act just like a USR call, except that you need not return a value, such as, LET X = USR nnnn.

To turn off this command, POKE 16393,0 (or any even number). In machine code use FD3509, which is DEC (IY+9). You can also use INC (IY+9) or RES 0, (IY+9). It's your choice. This byte is saved with your program and RAND USR calls could present a problem. It is a good idea to initialize this in a subroutine when you use it. Entering a program line will not invoke this command, however a direct command without a line number will, so take care.

I am in the process of writing a driver that will link (hopefully) relocatable subroutines together and actually extend the Sinclair Basic operating system. I will let you know when I have something worthwhile. I have a few things in mind, but I am open for both suggestions and submissions. Unfortunately, my duties at SyncWare News prevent me from spending all the time on this project that I would like to put in on it. I do hope that you enjoy it though.

INSTALLATION INSTRUCTIONS:

BEWARE OF STATIC ELECTRICITY

Turn your computer over and remove the 5 small screws holding it together. Remove the back and unscrew the 2 screws holding the PC board to the top half. Gently turn the PC board over exposing the flip side of the board. (Be careful with the keyboard connector. Don't kink it.) Locate the ROM. It is the one that is too small for its socket. Pry it up with a long thin screwdriver. Insert the eprom and its socket in the ROM's place. Make sure that all the socket pins are seated properly before you firmly press the sockets together. (If you break a pin, believe me, soldering those little jumper wires is a real bear!) Close up your case, run it and forget it!

The circuit will fit well in a TS1000, but may not fit in a ZX81 depending on how old it is (due to a redesign of the board). A single socket may be used, but this requires soldering on the eprom. The Eprom may also be used in a 1500, but it again requires soldering on the eprom. It has come to my attention that there are some TS1000's that have the ROM soldered in place. Don't worry. Just clip it out with some small wire cutters. Get one of those blue, suction type desolders (Radio Shack) and clean up the board. You can solder in the socket circuit or get a 28 pin low profile socket and solder it in. Plug in the EPROM and run it! If you have any questions or trouble, drop me a line or call me in the evenings at 301-██████████.

ZX-81 EPROM UPGRADE CHANGES

0000	03FD		OUT FD,A
0002	210080		LD HL,8000
0005	03C903		JP INIT
0008	2A1640	ERR0	LD HL,(CHADD)
000B	221640		LD (X PTR),HL
000E	1646		JR ERRR
0010	A7	INPR	AND A
0011	02F107		JP NZ FRCH
0014	03F507		JP PR3P

;0002 Reflects a preset Ramtop (a la 1500)
;0005 Jump to the proper INIT point

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0340	0E01	LDBY	LD C,01
034E	0E00	LNXB	LD B,00
0350	3E7F	AGIN	LD A,7F
0352	0BFE		IN A,FE
0354	03FF		OUT FF,A
0356	1F		RRR
0357	3049		JR NC LFAL
0359	17		RLA
035A	17		RLA
035B	3828		JR C LBIT
035D	10F1		DJNZ AGIN
035F	F1		POP AF
0360	BA		CP D
0361	3063	NOLD	JR NC BOLD
0363	00		NOP
0364	62		LD H,D
0365	6B		LD L,E
0366	004C03	NMIN	CALL LDBY

;0361 This change changes where you go in case of a BaD Load. This location was changed primarily to make more consecutive space in the INIT routine. However, it does make this routine function properly.

;0363 This NOP clears the garbage left by the change from the 3 byte (jump) to the 2 byte (jump relative) command

03C3	0DE702	NEW	CALL TFAS
03C6	2A0440	BOLD	LD HL, RAMTP
03C9	54	INIT	LD D,H
03CA	5D		LD E,L
03CB	0E3F		LD A,3F
03CD	2B		DEC HL
03CE	3600	CLER	LD (HL),00
03D0	2B	16K-	DEC HL
03D1	BC		CP H
03D2	20FA		JR NZ CLER
03D4	EB		EX DE,HL
03D5	1810		JR MORE
03D7	0DA60D	LINE	CALL FL37
03DA	2804	CHEK	JR Z NOST
03DC	FDCB0046	FLAG	BIT 0,(VERSN)
03DE	CACB0A	NOST	JP Z LPRN
03E3	2A3240	YEST	LD HL,(SEED)
03E6	E9	JUMP	JP (HL)
03E7	220440	MORE	LD (RAMTP),HL
03EA	2B	INIT	DEC HL
03EB	363E		LD (HL),3E
03ED	2B		DEC HL
03EE	F9		LD SP,HL
03EF	2B		DEC HL
03F0	2B		DEC HL
03F1	220240		LD (RASP),HL
03F4	3E1E		LD A,1E
03F6	ED47		LD I,A
03F8	ED56		IN 1
03FA	FD210040		LD IY,ERRNR
03FE	FD363840		LD (ODFLG),40
0402	217040		LD HL,407D
0405	2200C40		LD (OFILE),HL
0408	0619	LILO	LD B,19
040A	0D570A		CALL MAKE
040D	221040		LD (WARP),HL
0410	0D9A14		CALL CLER
0413	0DAD14	BASI	CALL K-EL
0416	0D230F		CALL FAST
0419	0D2A0A	UPPR	CALL CL3
041C	2A0840		LD HL,(S APC)
041F	ED5B2340		LD DE,(S TOP)
0423	A7		AND A
0424	ED52		SBC HL,DE

;03C3 This INIT routine is completely re-written in order to both speed up and add other changes. BC is no longer used and therefore contains 0000 when not in use (instead of a number near ramtop).

; The memory check is no longer present, so you must have at least 16K in order to function properly. A 2K machine will initialize and take BASIC commands, but as soon as you over-write your phantom stack pointer, good-bye. (This is due to partial decoding and repeating of memory segments in a 2K machine.)

;03D7 This is the new location of LPRINT. First you check to see if Syntax is being tested, by checking BIT 7 of Flags. If you are entering a line, then you go to the regular LPRINT routine. If you enter a direct command or are running a program, then you test BIT 0 of VERSN. If it is 0 then you again jump to the LPRINT routine. If it is 1, then you get the number set by RAND and jump to that location. There is no commercial software other than the AERCO printer interface that uses this byte (VERSN) That I know of. They do not use BIT 0 though.

;040A Make the display. This routine was relocated in order to make more space above.

;0416 This one byte change serves a double purpose. It completes initialization in fast mode, and everytime you key in an empty cursor or enter a line you come back in FAST mode.

```

0A2A 0016 CLS LD B,16
0A2C F0C8016E CLLN RES 1,(FLAGS)
0A30 0E21 LD C,21
0A32 06 PUSH BC
0A3C 0D1888 FULL CALL SEDF
0A3E 01 DIS- POP BC
0A3F F0C83AFE PLAY SET 7,(SP03L)
0A3B AF XOR A
0A3C 0DF507 CALL PRSP
0A3F 2A3948 LD HL,(SP03N)
0A42 7D LD A,L
0A43 B4 OR H
0A44 E67E AND 7E
0A46 20F3 JR NZ 0A3B
0A48 031809 DONE JP SEDF
0A4B 0620 SCRL LD B,20
0A4D AF PT2- XOR A
0A4E 2B DEC HL
0A4F 77 LD (HL),A
0A50 10FC DJNZ 0A4E
0A52 012103 LD BC,0321
0A55 10F1 JR DONE
0A57 3678 MAKE LD (HL),78
0A59 23 DIS- INC HL
0A5A 10FB PLAY DJNZ MAKE
0A5C 09 RET
0A5D 0D170A MCLE CALL R308
0A60 06 MHCL PUSH BC
0A61 78 LD A,B
0A62 2F CPL
0A63 47 LD B,A
0A64 79 LD A,C
0A65 27 CPL
0A66 4F LD C,A
0A67 03 INC BC
0A68 0DAD09 CALL ADPT
0A6B EB EX DE,HL
0A6C E1 POP HL
0A6D 19 ADD HL,DE
0A6E 06 PUSH DE
0A6F EDB0 LDIR
0A71 E1 POP HL
0A72 09 RET
0A73 2A1440 ELNR LD HL,(ELINE)

```

```

0C0E 2A0040 SCRL LD HL,(DFILE)
0C11 03 INC HL
0C12 05 PUSH HL
0C13 112100 CP DE,0321
0C15 1104 ADD HL,DE
0C17 04 POP DE
0C18 0615 LD B,15
0C19 05 PUSH BC
0C1B 012800 LD BC,0128
0C1D 06B0 LDIR
0C1E 13 INC DE
0C1F 03 INC HL
0C21 04 POP BC
0C22 0675 DJNZ 0C1B
0C23 2B DEC HL
0C25 0D4B0A JP SCLE
0C26 06B0 ADD DE,HL
0C27 03 INC HL
0C28 06B0 ADD HL,HL
0C29 03 INC HL
0C2A 06B0 ADD HL,A
0C2B 03 INC HL
0C2C 06B0 ADD HL,A
0C2D 03 INC HL
0C2E 06B0 ADD HL,A
0C2F 03 INC HL
0C30 06B0 ADD HL,A
0C31 03 INC HL
0C32 06B0 ADD HL,A
0C33 03 INC HL
0C34 06B0 ADD HL,A
0C35 03 INC HL
0C36 06B0 ADD HL,A
0C37 03 INC HL
0C38 06B0 ADD HL,A
0C39 03 INC HL
0C3A 06B0 ADD HL,A
0C3B 03 INC HL
0C3C 06B0 ADD HL,A
0C3D 03 INC HL
0C3E 06B0 ADD HL,A
0C3F 03 INC HL
0C40 06B0 ADD HL,A
0C41 03 INC HL
0C42 06B0 ADD HL,A
0C43 03 INC HL
0C44 06B0 ADD HL,A
0C45 03 INC HL
0C46 06B0 ADD HL,A
0C47 03 INC HL
0C48 06B0 ADD HL,A
0C49 03 INC HL
0C4A 06B0 ADD HL,A
0C4B 03 INC HL
0C4C 06B0 ADD HL,A
0C4D 03 INC HL
0C4E 06B0 ADD HL,A
0C4F 03 INC HL
0C50 06B0 ADD HL,A
0C51 03 INC HL
0C52 06B0 ADD HL,A
0C53 03 INC HL
0C54 06B0 ADD HL,A
0C55 03 INC HL
0C56 06B0 ADD HL,A
0C57 03 INC HL
0C58 06B0 ADD HL,A
0C59 03 INC HL
0C5A 06B0 ADD HL,A
0C5B 03 INC HL
0C5C 06B0 ADD HL,A
0C5D 03 INC HL
0C5E 06B0 ADD HL,A
0C5F 03 INC HL
0C60 06B0 ADD HL,A
0C61 03 INC HL
0C62 06B0 ADD HL,A
0C63 03 INC HL
0C64 06B0 ADD HL,A
0C65 03 INC HL
0C66 06B0 ADD HL,A
0C67 03 INC HL
0C68 06B0 ADD HL,A
0C69 03 INC HL
0C6A 06B0 ADD HL,A
0C6B 03 INC HL
0C6C 06B0 ADD HL,A
0C6D 03 INC HL
0C6E 06B0 ADD HL,A
0C6F 03 INC HL
0C70 06B0 ADD HL,A
0C71 03 INC HL
0C72 06B0 ADD HL,A
0C73 03 INC HL
0C74 06B0 ADD HL,A
0C75 03 INC HL
0C76 06B0 ADD HL,A
0C77 03 INC HL
0C78 06B0 ADD HL,A
0C79 03 INC HL
0C7A 06B0 ADD HL,A
0C7B 03 INC HL
0C7C 06B0 ADD HL,A
0C7D 03 INC HL
0C7E 06B0 ADD HL,A
0C7F 03 INC HL
0C80 06B0 ADD HL,A
0C81 03 INC HL
0C82 06B0 ADD HL,A
0C83 03 INC HL
0C84 06B0 ADD HL,A
0C85 03 INC HL
0C86 06B0 ADD HL,A
0C87 03 INC HL
0C88 06B0 ADD HL,A
0C89 03 INC HL
0C8A 06B0 ADD HL,A
0C8B 03 INC HL
0C8C 06B0 ADD HL,A
0C8D 03 INC HL
0C8E 06B0 ADD HL,A
0C8F 03 INC HL
0C90 06B0 ADD HL,A
0C91 03 INC HL
0C92 06B0 ADD HL,A
0C93 03 INC HL
0C94 06B0 ADD HL,A
0C95 03 INC HL
0C96 06B0 ADD HL,A
0C97 03 INC HL
0C98 06B0 ADD HL,A
0C99 03 INC HL
0C9A 06B0 ADD HL,A
0C9B 03 INC HL
0C9C 06B0 ADD HL,A
0C9D 03 INC HL
0C9E 06B0 ADD HL,A
0C9F 03 INC HL
0CA0 06B0 ADD HL,A
0CA1 03 INC HL
0CA2 06B0 ADD HL,A
0CA3 03 INC HL
0CA4 06B0 ADD HL,A
0CA5 03 INC HL
0CA6 06B0 ADD HL,A
0CA7 03 INC HL
0CA8 06B0 ADD HL,A
0CA9 03 INC HL
0CAA 06B0 ADD HL,A
0CAB 03 INC HL
0CAC 06B0 ADD HL,A
0CAD 03 INC HL
0CAE 06B0 ADD HL,A
0CAF 03 INC HL
0CB0 06B0 ADD HL,A
0CB1 03 INC HL
0CB2 06B0 ADD HL,A
0CB3 03 INC HL
0CB4 06B0 ADD HL,A
0CB5 03 INC HL
0CB6 06B0 ADD HL,A
0CB7 03 INC HL
0CB8 06B0 ADD HL,A
0CB9 03 INC HL
0CBA 06B0 ADD HL,A
0CBB 03 INC HL
0CBC 06B0 ADD HL,A
0CBD 03 INC HL
0CBE 06B0 ADD HL,A
0CBF 03 INC HL
0CC0 06B0 ADD HL,A
0CC1 03 INC HL
0CC2 06B0 ADD HL,A
0CC3 03 INC HL
0CC4 06B0 ADD HL,A
0CC5 03 INC HL
0CC6 06B0 ADD HL,A
0CC7 03 INC HL
0CC8 06B0 ADD HL,A
0CC9 03 INC HL
0CCA 06B0 ADD HL,A
0CCB 03 INC HL
0CCC 06B0 ADD HL,A
0CCD 03 INC HL
0CCE 06B0 ADD HL,A
0CCF 03 INC HL
0CD0 06B0 ADD HL,A
0CD1 03 INC HL
0CD2 06B0 ADD HL,A
0CD3 03 INC HL
0CD4 06B0 ADD HL,A
0CD5 03 INC HL
0CD6 06B0 ADD HL,A
0CD7 03 INC HL
0CD8 06B0 ADD HL,A
0CD9 03 INC HL
0CDA 06B0 ADD HL,A
0CDB 03 INC HL
0CDC 06B0 ADD HL,A
0CDD 03 INC HL
0CDE 06B0 ADD HL,A
0CDF 03 INC HL
0CE0 06B0 ADD HL,A
0CE1 03 INC HL
0CE2 06B0 ADD HL,A
0CE3 03 INC HL
0CE4 06B0 ADD HL,A
0CE5 03 INC HL
0CE6 06B0 ADD HL,A
0CE7 03 INC HL
0CE8 06B0 ADD HL,A
0CE9 03 INC HL
0CEA 06B0 ADD HL,A
0CEB 03 INC HL
0CEC 06B0 ADD HL,A
0CED 03 INC HL
0CEE 06B0 ADD HL,A
0CEF 03 INC HL
0CF0 06B0 ADD HL,A
0CF1 03 INC HL
0CF2 06B0 ADD HL,A
0CF3 03 INC HL
0CF4 06B0 ADD HL,A
0CF5 03 INC HL
0CF6 06B0 ADD HL,A
0CF7 03 INC HL
0CF8 06B0 ADD HL,A
0CF9 03 INC HL
0CFA 06B0 ADD HL,A
0CFB 03 INC HL
0CFC 06B0 ADD HL,A
0CFD 03 INC HL
0CFE 06B0 ADD HL,A
0CFF 03 INC HL
0D00 06B0 ADD HL,A
0D01 03 INC HL
0D02 06B0 ADD HL,A
0D03 03 INC HL
0D04 06B0 ADD HL,A
0D05 03 INC HL
0D06 06B0 ADD HL,A
0D07 03 INC HL
0D08 06B0 ADD HL,A
0D09 03 INC HL
0D0A 06B0 ADD HL,A
0D0B 03 INC HL
0D0C 06B0 ADD HL,A
0D0D 03 INC HL
0D0E 06B0 ADD HL,A
0D0F 03 INC HL
0D10 06B0 ADD HL,A
0D11 03 INC HL
0D12 06B0 ADD HL,A
0D13 03 INC HL
0D14 06B0 ADD HL,A
0D15 03 INC HL
0D16 06B0 ADD HL,A
0D17 03 INC HL
0D18 06B0 ADD HL,A
0D19 03 INC HL
0D1A 06B0 ADD HL,A
0D1B 03 INC HL
0D1C 06B0 ADD HL,A
0D1D 03 INC HL
0D1E 06B0 ADD HL,A
0D1F 03 INC HL
0D20 06B0 ADD HL,A
0D21 03 INC HL
0D22 06B0 ADD HL,A
0D23 03 INC HL
0D24 06B0 ADD HL,A
0D25 03 INC HL
0D26 06B0 ADD HL,A
0D27 03 INC HL
0D28 06B0 ADD HL,A
0D29 03 INC HL
0D2A 06B0 ADD HL,A
0D2B 03 INC HL
0D2C 06B0 ADD HL,A
0D2D 03 INC HL
0D2E 06B0 ADD HL,A
0D2F 03 INC HL
0D30 06B0 ADD HL,A
0D31 03 INC HL
0D32 06B0 ADD HL,A
0D33 03 INC HL
0D34 06B0 ADD HL,A
0D35 03 INC HL
0D36 06B0 ADD HL,A
0D37 03 INC HL
0D38 06B0 ADD HL,A
0D39 03 INC HL
0D3A 06B0 ADD HL,A
0D3B 03 INC HL
0D3C 06B0 ADD HL,A
0D3D 03 INC HL
0D3E 06B0 ADD HL,A
0D3F 03 INC HL
0D40 06B0 ADD HL,A
0D41 03 INC HL
0D42 06B0 ADD HL,A
0D43 03 INC HL
0D44 06B0 ADD HL,A
0D45 03 INC HL
0D46 06B0 ADD HL,A
0D47 03 INC HL
0D48 06B0 ADD HL,A
0D49 03 INC HL
0D4A 06B0 ADD HL,A
0D4B 03 INC HL
0D4C 06B0 ADD HL,A
0D4D 03 INC HL
0D4E 06B0 ADD HL,A
0D4F 03 INC HL
0D50 06B0 ADD HL,A
0D51 03 INC HL
0D52 06B0 ADD HL,A
0D53 03 INC HL
0D54 06B0 ADD HL,A
0D55 03 INC HL
0D56 06B0 ADD HL,A
0D57 03 INC HL
0D58 06B0 ADD HL,A
0D59 03 INC HL
0D5A 06B0 ADD HL,A
0D5B 03 INC HL
0D5C 06B0 ADD HL,A
0D5D 03 INC HL
0D5E 06B0 ADD HL,A
0D5F 03 INC HL
0D60 06B0 ADD HL,A
0D61 03 INC HL
0D62 06B0 ADD HL,A
0D63 03 INC HL
0D64 06B0 ADD HL,A
0D65 03 INC HL
0D66 06B0 ADD HL,A
0D67 03 INC HL
0D68 06B0 ADD HL,A
0D69 03 INC HL
0D6A 06B0 ADD HL,A
0D6B 03 INC HL
0D6C 06B0 ADD HL,A
0D6D 03 INC HL
0D6E 06B0 ADD HL,A
0D6F 03 INC HL
0D70 06B0 ADD HL,A
0D71 03 INC HL
0D72 06B0 ADD HL,A
0D73 03 INC HL
0D74 06B0 ADD HL,A
0D75 03 INC HL
0D76 06B0 ADD HL,A
0D77 03 INC HL
0D78 06B0 ADD HL,A
0D79 03 INC HL
0D7A 06B0 ADD HL,A
0D7B 03 INC HL
0D7C 06B0 ADD HL,A
0D7D 03 INC HL
0D7E 06B0 ADD HL,A
0D7F 03 INC HL
0D80 06B0 ADD HL,A
0D81 03 INC HL
0D82 06B0 ADD HL,A
0D83 03 INC HL
0D84 06B0 ADD HL,A
0D85 03 INC HL
0D86 06B0 ADD HL,A
0D87 03 INC HL
0D88 06B0 ADD HL,A
0D89 03 INC HL
0D8A 06B0 ADD HL,A
0D8B 03 INC HL
0D8C 06B0 ADD HL,A
0D8D 03 INC HL
0D8E 06B0 ADD HL,A
0D8F 03 INC HL
0D90 06B0 ADD HL,A
0D91 03 INC HL
0D92 06B0 ADD HL,A
0D93 03 INC HL
0D94 06B0 ADD HL,A
0D95 03 INC HL
0D96 06B0 ADD HL,A
0D97 03 INC HL
0D98 06B0 ADD HL,A
0D99 03 INC HL
0D9A 06B0 ADD HL,A
0D9B 03 INC HL
0D9C 06B0 ADD HL,A
0D9D 03 INC HL
0D9E 06B0 ADD HL,A
0D9F 03 INC HL
0DA0 06B0 ADD HL,A
0DA1 03 INC HL
0DA2 06B0 ADD HL,A
0DA3 03 INC HL
0DA4 06B0 ADD HL,A
0DA5 03 INC HL
0DA6 06B0 ADD HL,A
0DA7 03 INC HL
0DA8 06B0 ADD HL,A
0DA9 03 INC HL
0DAA 06B0 ADD HL,A
0DAB 03 INC HL
0DAC 06B0 ADD HL,A
0DAD 03 INC HL
0DAE 06B0 ADD HL,A
0DAF 03 INC HL
0DB0 06B0 ADD HL,A
0DB1 03 INC HL
0DB2 06B0 ADD HL,A
0DB3 03 INC HL
0DB4 06B0 ADD HL,A
0DB5 03 INC HL
0DB6 06B0 ADD HL,A
0DB7 03 INC HL
0DB8 06B0 ADD HL,A
0DB9 03 INC HL
0DBA 06B0 ADD HL,A
0DBB 03 INC HL
0DBC 06B0 ADD HL,A
0DBD 03 INC HL
0DBE 06B0 ADD HL,A
0DBF 03 INC HL
0DC0 06B0 ADD HL,A
0DC1 03 INC HL
0DC2 06B0 ADD HL,A
0DC3 03 INC HL
0DC4 06B0 ADD HL,A
0DC5 03 INC HL
0DC6 06B0 ADD HL,A
0DC7 03 INC HL
0DC8 06B0 ADD HL,A
0DC9 03 INC HL
0DCA 06B0 ADD HL,A
0DCB 03 INC HL
0DCC 06B0 ADD HL,A
0DCD 03 INC HL
0DCE 06B0 ADD HL,A
0DCF 03 INC HL
0DD0 06B0 ADD HL,A
0DD1 03 INC HL
0DD2 06B0 ADD HL,A
0DD3 03 INC HL
0DD4 06B0 ADD HL,A
0DD5 03 INC HL
0DD6 06B0 ADD HL,A
0DD7 03 INC HL
0DD8 06B0 ADD HL,A
0DD9 03 INC HL
0DDA 06B0 ADD HL,A
0DDB 03 INC HL
0DDC 06B0 ADD HL,A
0DDD 03 INC HL
0DDE 06B0 ADD HL,A
0DDF 03 INC HL
0DE0 06B0 ADD HL,A
0DE1 03 INC HL
0DE2 06B0 ADD HL,A
0DE3 03 INC HL
0DE4 06B0 ADD HL,A
0DE5 03 INC HL
0DE6 06B0 ADD HL,A
0DE7 03 INC HL
0DE8 06B0 ADD HL,A
0DE9 03 INC HL
0DEA 06B0 ADD HL,A
0DEB 03 INC HL
0DEC 06B0 ADD HL,A
0DED 03 INC HL
0DEE 06B0 ADD HL,A
0DEF 03 INC HL
0DF0 06B0 ADD HL,A
0DF1 03 INC HL
0DF2 06B0 ADD HL,A
0DF3 03 INC HL
0DF4 06B0 ADD HL,A
0DF5 03 INC HL
0DF6 06B0 ADD HL,A
0DF7 03 INC HL
0DF8 06B0 ADD HL,A
0DF9 03 INC HL
0DFA 06B0 ADD HL,A
0DFB 03 INC HL
0DFC 06B0 ADD HL,A
0DFD 03 INC HL
0DFE 06B0 ADD HL,A
0DFF 03 INC HL
0E00 06B0 ADD HL,A
0E01 03 INC HL
0E02 06B0 ADD HL,A
0E03 03 INC HL
0E04 06B0 ADD HL,A
0E05 03 INC HL
0E06 06B0 ADD HL,A
0E07 03 INC HL
0E08 06B0 ADD HL,A
0E09 03 INC HL
0E0A 06B0 ADD HL,A
0E0B 03 INC HL
0E0C 06B0 ADD HL,A
0E0D 03 INC HL
0E0E 06B0 ADD HL,A
0E0F 03 INC HL
0E10 06B0 ADD HL,A
0E11 03 INC HL
0E12 06B0 ADD HL,A
0E13 03 INC HL
0E14 06B0 ADD HL,A
0E15 03 INC HL
0E16 06B0 ADD HL,A
0E17 03 INC HL
0E18 06B0 ADD HL,A
0E19 03 INC HL
0E1A 06B0 ADD HL,A
0E1B 03 INC HL
0E1C 06B0 ADD HL,A
0E1D 03 INC HL
0E1E 06B0 ADD HL,A
0E1F 03 INC HL
0E20 06B0 ADD HL,A
0E21 03 INC HL
0E22 06B0 ADD HL,A
0E23 03 INC HL
0E24 06B0 ADD HL,A
0E25 03 INC HL
0E26 06B0 ADD HL,A
0E27 03 INC HL
0E28 06B0 ADD HL,A
0E29 03 INC HL
0E2A 06B0 ADD HL,A
0E2B 03 INC HL
0E2C 06B0 ADD HL,A
0E2D 03 INC HL
0E2E 06B0 ADD HL,A
0E2F 03 INC HL
0E30 06B0 ADD HL,A
0E31 03 INC HL
0E32 06B0 ADD HL,A
0E33 03 INC HL
0E34 06B0 ADD HL,A
0E35 03 INC HL
0E36 06B0 ADD HL,A
0E37 03 INC HL
0E38 06B0 ADD HL,A
0E39 03 INC HL
0E3A 06B0 ADD HL,A
0E3B 03 INC HL
0E3C 06B0 ADD HL,A
0E3D 03 INC HL
0E3E 06B0 ADD HL,A
0E3F 03 INC HL
0E40 06B0 ADD HL,A
0E41 03 INC HL
0E42 06B0 ADD HL,A
0E43 03 INC HL
0E44 06B0 ADD HL,A
0E45 03 INC HL
0E46 06B0 ADD HL,A
0E47 03 INC HL
0E48 06B0 ADD HL,A
0E49 03 INC HL
0E4A 06B0 ADD HL,A
0E4B 03 INC HL
0E4C 06B0 ADD HL,A
0E4D 03 INC HL
0E4E 06B0 ADD HL,A
0E4F 03 INC HL
0E50 06B0 ADD HL,A
0E51 03 INC HL
0E52 06B0 ADD HL,A
0E53 03 INC HL
0E54 06B0 ADD HL,A
0E55 03 INC HL
0E56 06B0 ADD HL,A
0E57 03 INC HL
0E58 06B0 ADD HL,A
0E59 03 INC HL
0E5A 06B0 ADD HL,A
0E5B 03 INC HL
0E5C 06B0 ADD HL,A
0E5D 03 INC HL
0E5E 06B0 ADD HL,A
0E5F 03 INC HL
0E60 06B0 ADD HL,A
0E61 03 INC HL
0E62 06B0 ADD HL,A
0E63 03 INC HL
0E64 06B0 ADD HL,A
0E65 03 INC HL
0E66 06B0 ADD HL,A
0E67 03 INC HL
0E68 06B0 ADD HL,A
0E69 03 INC HL
0E6A 06B0 ADD HL,A
0E6B 03 INC HL
0E6C 06B0 ADD HL,A
0E6D 03 INC HL
0E6E 06B0 ADD HL,A
0E6F 03 INC HL
0E70 06B0 ADD HL,A
0E71 03 INC HL
0E72 06B0 ADD HL,A
0E73 03 INC HL
0E74 06B0 ADD HL,A
0E75 03 INC HL
0E76 06B0 ADD HL,A
0E77 03 INC HL
0E78 06B0 ADD HL,A
0E79 03 INC HL
0E7A 06B0 ADD HL,A
0E7B 03 INC HL
0E7C 06B0 ADD HL,A
0E7D 03 INC HL
0E7E 06B0 ADD HL,A
0E7F 03 INC HL
0E80 06B0 ADD HL,A
0E81 03 INC HL
0E82 06B0 ADD HL,A
0E83 03 INC HL
0E84 06B0 ADD HL,A
0E85 03 INC HL
0E86 06B0 ADD HL,A
0E87 03 INC HL
0E88 06B0 ADD HL,A
0E89 03 INC HL
0E8A 06B0 ADD HL,A
0E8B 03 INC HL
0E8C 06B0 ADD HL,A
0E8D 03 INC HL
0E8E 06B0 ADD HL,A
0E8F 03 INC HL
0E90 06B0 ADD HL,A
0E91 03 INC HL
0E92 06B0 ADD HL,A
0E93 03 INC HL
0E94 06B0 ADD HL,A
0E95 03 INC HL
0E96 06B0 ADD HL,A
0E97 03 INC HL
0E98 06B0 ADD HL,A
0E99 03 INC HL
0E9A 06B0 ADD HL,A
0E9B 03 INC HL
0E9C 06B0 ADD HL,A
0E9D 03 INC HL
0E9E 06B0 ADD HL,A
0E9F 03 INC HL
0EA0 06B0 ADD HL,A
0EA1 03 INC HL
0EA2 06B0 ADD HL,A
0EA3 03 INC HL
0EA4 06B0 ADD HL,A
0EA5 03 INC HL
0EA6 06B0 ADD HL,A
0EA7 03 INC HL
0EA8 06B0 ADD HL,A
0EA9 03 INC HL
0EAA 06B0 ADD HL,A
0EAB 03 INC HL
0EAC 06B0 ADD HL,A
0EAD 03 INC HL
0EAE 06B0 ADD HL,A
0EAF 03 INC HL
0EB0 06B0 ADD HL,A
0EB1 03 INC HL
0EB2 06B0 ADD HL,A
0EB3 03 INC HL
0EB4 06B0 ADD HL,A
0EB5 03 INC HL
0EB6 06B0 ADD HL,A
0EB7 03 INC HL
0EB8 06B0 ADD HL,A
0EB9 03 INC HL
0EBA 06B0 ADD HL,A
0EBB 03 INC HL
0EBC 06B0 ADD HL,A
0EBD 03 INC HL
0EBE 06B0 ADD HL,A
0EBF 03 INC HL
0EC0 06B0 ADD HL,A
0EC1 03 INC HL
0EC2 06B0 ADD HL,A
0EC3 03 INC HL
0EC4 06B0 ADD HL,A
0EC5 03 INC HL
0EC6 06B0 ADD HL,A
0EC7 03 INC HL
0EC8 06B0 ADD HL,A
0EC9 03 INC HL
0ECA 06B0 ADD HL,A
0ECB 03 INC HL
0ECC 06B0 ADD HL,A
0ECD 03 INC HL
0ECE 06B0 ADD HL,A
0ECF 03 INC HL
0ED0 06B0 ADD HL,A
0ED1 03 INC HL
0ED2 06B0 ADD HL,A
0ED3 03 INC HL
0ED4 06B0 ADD HL,A
0ED5 03 INC HL
0ED6 06B0 ADD HL,A
0ED7 03 INC HL
0ED8 06B0 ADD HL,A
0ED9 03 INC HL
0EDA 06B0 ADD HL,A
0EDB 03 INC HL
0EDC 06B0 ADD HL,A
0EDD 03 INC HL
0EDE 06B0 ADD HL,A
0EDF 03 INC HL
0EE0 06B0 ADD HL,A
0EE1 03 INC HL
0EE2 06B0 ADD HL,A
0EE3 03 INC HL
0EE4 06B0 ADD HL,A
0EE5 03 INC HL
0EE6 06B0 ADD HL,A
0EE7 03 INC HL
0EE8 06B0 ADD HL,A
0EE9 03 INC HL
0EEA 06B0 ADD HL,A
0EEB 03 INC HL
0EEC 06B0 ADD HL,A
0EED 03 INC HL
0EEF 06B0 ADD HL,A
0EF0 06B0 ADD HL,A
0EF1 03 INC HL
0EF2 06B0 ADD HL,A
0EF3 03 INC HL
0EF4 06B0 ADD HL,A
0EF5 03 INC HL
0EF6 06B0 ADD HL,A
0EF7 03 INC HL
0EF8 06B0 ADD HL,A
0EF9 03 INC HL
0EFA 06B0 ADD HL,A
0EFB 03 INC HL
0EFC 06B0 ADD HL,A
0EFD 03 INC HL
0EFE 06B0 ADD HL,A
0EFF 03 INC HL
0F00 06B0 ADD HL,A
0F01 03 INC HL
0F02 06B0 ADD HL,A
0F03 03 INC HL
0F04 06B0 ADD HL,A
0F05 03 INC HL
0F06 06B0 ADD HL,A
0F07 03 INC HL
0F08 06B0 ADD HL,A
0F09 03 INC HL
0F0A 06B0 ADD HL,A
0F0B 03 INC HL
0F0C 06B0 ADD HL,A
0F0D 03 INC HL
0F0E 06B0 ADD HL,A
0F0F 03 INC HL
0F10 06B0 ADD HL,A
0F11 03 INC HL
0F12 06B0 ADD HL,A
0F13 03 INC HL
0F14 06B0 ADD HL,A
0F15 03 INC HL
0F16 06B0 ADD HL,A
0F17 03 INC HL
0F18 06B0 ADD HL,A
0F19 03 INC HL
0F1A 06B0 ADD HL,A
0F1B 03 INC HL
0F1C 06B0 ADD HL,A
0F1D 03 INC HL
0F1E 06B0 ADD HL,A
0F1F 03 INC HL
0F20 06B0 ADD HL,A
0F21 03 INC HL
0F22 06B0 ADD HL,A
0F23 03 INC HL
0F24 06B0 ADD HL,A
0F25 03 INC HL
0F26 06B0 ADD HL,A
0F27 03 INC HL
0F28 06B0 ADD HL,A
0F29 03 INC HL
0F2A 06B0 ADD HL,A
0F2B 03 INC HL
0F2C 06B0 ADD HL,A
0F2D 03 INC HL
0F2E 06B0 ADD HL,A
0F2F 03 INC HL
0F30 06B0 ADD HL,A
0F31 03 INC HL
0F32 06B0 ADD HL,A
0F33 03 INC HL
0F34 06B0 ADD HL,A
0F35 03 INC HL
0F36 06B0 ADD HL,A
0F37 03 INC HL
0F38 06B0 ADD HL,A
0F39 03 INC HL
0F3A 06B0 ADD HL,A
0F3B 03 INC HL
0F3C 06B0 ADD HL,A
0F3D 03 INC HL
0F3E 06B0 ADD HL,A
0F3F 03 INC HL
0F40 06B0 ADD HL,A
0F41 03 INC HL
0F42 06B0 ADD HL,A
0F43 03 INC HL
0F44 06B0 ADD HL,A
0F45 03 INC HL
0F46 06B0 ADD HL,A
0F47 03 INC HL
0F48 06B0 ADD HL,A
0F49 03 INC HL
0F4A 06B0 ADD HL,A
0F4B 03 INC HL
0F4C 06B0 ADD HL,A
0F4D 03 INC HL
0F4E 06B0 ADD HL,A
0F4F 03 INC HL
0F50 06B0 ADD HL,A
0F51 03 INC HL
0F52 06B0 ADD HL,A
0F53 03 INC HL
0F54 06B0 ADD HL,A
0F55 03 INC HL
0F56 06B0 ADD HL,A
0F57 03 INC HL
0F58 06B0 ADD HL,A
0F59 03 INC HL
0F5A 06B0 ADD HL,A
0F5B 03 INC HL
0F5C 06B0 ADD HL,A
0F5D 03 INC HL
0F5E 06B0 ADD HL,A
0F5F 03 INC HL
0F60 06B0 ADD HL,A
0F61 03 INC HL
0F62 06B0 ADD HL,A
0F63 03 INC HL
0F64 06B0 ADD HL,A
0F65 03 INC HL
0F66 06B0 ADD HL,A
0F67 03 INC HL
0F68 06B0 ADD HL,A
0F69 03 INC HL
0F6A 06B0 ADD HL,A
0F6B 03 INC HL
0F6C 06B0 ADD HL,A
0F6D 03 INC HL
0F6E 06B0 ADD HL,A
0F6F 03 INC HL
0F70 06B0 ADD HL,A
0F71 03 INC HL
0F72 06B0 ADD HL,A
0F73 03 INC HL
0F74 06B0 ADD HL,A
0F75 03 INC HL
0F76 06B0 ADD HL,A
0F77 03 INC HL
0F78 06B0 ADD HL,A
0F79 03 INC HL
0F7A 06B0 ADD HL,A
0F7B 03 INC HL
0F7C 06B0 ADD HL,A
0F7D 03 INC HL
0F7E 06B0 ADD HL,A
0F7F 03 INC HL
0F80 06B0 ADD HL,A
0F81 03 INC HL
0F82 06B0 ADD HL,A
0F83 03 INC HL
0F84 06B0 ADD HL,A
0F85 03 INC HL
0F86 06B0 ADD HL,A
0F87 03 INC HL
0F88 06B0 ADD HL,A
0F89 03 INC HL
0F8A 06B0 ADD HL,A
0F8B 03 INC HL
0F8C 06B0 ADD HL,A
0F8D 03 INC HL
0F8E 06B0 ADD HL,A
0F8F 03 INC HL
0F90 06B0 ADD HL,A
0F91 03 INC HL
0F92 06B0 ADD HL,A
0F93 03 INC HL
0F94 06B0 ADD HL,A
0F95 03 INC HL
0F96 06B0 ADD HL,A
0F97 03 INC HL
0F98 06B0 ADD HL,A
0F99 03 INC HL
0F9A 06B0 ADD HL,A
0F9B 03 INC HL
0F9C 06B0 ADD HL,A
0F9D 03 INC HL
0F9E 06B0 ADD HL,A
0F9F 03 INC HL
0FA0 06B0 ADD HL,A
0FA1 03 INC HL
0FA2 06B0 ADD HL,A
0FA3 03 INC HL
0FA4 06B0 ADD HL,A
0FA5 03 INC HL
0FA6 06B0 ADD HL,A
0FA7 03 INC HL
0FA8 06B0 ADD HL,A
0FA9 03 INC HL
0FAA 06B0 ADD HL,A
0FAB 03 INC HL
0FAC 06B0 ADD HL,A
0FAD 03 INC HL
0FAE 06B0 ADD HL,A
0FAF 03 INC HL
0FB0 06B0 ADD HL,A
0FB1 03 INC HL
0FB2 06B0 ADD HL,A
0FB3 03 INC HL
0FB4 06B0 ADD HL,A
0FB5 03 INC HL
0FB6 06B0 ADD HL,A
0FB7 03 INC HL
0FB8 06B0 ADD HL,A
0FB9 03 INC HL
0FBA 06B0 ADD HL,A
0FBB 03 INC HL
0FBC 06B0 ADD HL,A
0FBD 03 INC HL
0FBE 06B0 ADD HL,A
0FBF 03 INC HL
0FC0 06B0 ADD HL,A
0FC1 03 INC HL
0FC2 06B0 ADD HL,A
0FC3 03 INC HL
0FC4 06B0 ADD HL,A
0FC5 03 INC HL
0FC6 06B0 ADD HL,A
0FC7 03 INC HL
0FC8 06B0 ADD HL,A
0FC9 03 INC HL
0FCA 06B0 ADD HL,A
0FCB 03 INC HL
0FCC 06B0 ADD HL,A
0FCD 03 INC HL
0FCE 06B0 ADD HL,A
0FCF 03 INC HL
0FD0 06B0 ADD HL,A
0FD1 03 INC HL
0FD2 06B0 ADD HL,A
0FD3 03 INC HL
0FD4 06B0 ADD HL,A
0FD5 03 INC HL
0FD6 06B0 ADD HL,A
0FD7 03 INC HL
0FD8 06B0 ADD HL,A
0FD9 03 INC HL
0FDA 06B0 ADD HL,A
0FDB 03 INC HL
0FDC 06B0 ADD HL,A
0FDD 03 INC HL
0FDE 06B0 ADD HL,A
0FDF 03 INC HL
0FE0 06B0 ADD HL,A
0FE1 03 INC HL
0FE2 06B0 ADD HL,A
0FE3 03 INC HL
0FE4 06B0 ADD HL,A
0FE5 03 INC HL
0FE6 06B0 ADD HL,A
0FE7 03 INC HL
0FE8 06B0 ADD HL,A
0FE9 03 INC HL
0FEA 06B0 ADD HL,A
0FEB 03 INC HL
0FEC 06B0 ADD HL,A
0FED 03 INC HL
0FEE 06B0 ADD HL,A
0FEF 03 INC HL
0FF0 06B0 ADD HL,A
0FF1 03 INC HL
0FF2 06B0 ADD HL,A
0FF3 03 INC HL
0FF4 06B0 ADD HL,A
0FF5 03 INC HL
0FF6 06B0 ADD HL,A
0FF7 03 INC HL
0FF8 06B0 ADD HL,A
0FF9 03 INC HL
0FFA 06B0 ADD HL,A
0FFB 03 INC HL
0FFC 06B0 ADD HL,A
0FFD 03 INC HL
0FFE 06B0 ADD HL,A
0FFF 03 INC HL

```

;0A2A The CLS routine has been truncated to make more space for the SCROLL routine. It no longer collapses the display for any reason. Throughout each of the display and pointer setting routines, there are tests to see if room is available. Since there always is, all of the tests fall through and the machine runs slightly (though not noticeably) faster.

;0A4B This is the last part of the SCROLL routine. It does what the old routine did not. It pads out the line with blanks.

;0A52 This value sets the print position to the lower left the same as "PRINT AT 21,0;" (LD B,2100 and jump to the print at routine), but since the print at routine leaves 0321 in BC, why not bypass it and speed up the routine that much more.

;0A57 This is the create an empty screen routine. It was put here to make space elsewhere. It is only called from NEW. After the first CLS command (which is always done in FAST mode now), you then have a full display file and it stays that way.

;0C0E The SCROLL command is completely different, and in fact much faster than the old one. It is a modification of a program by Dan Tandberg, called Fast Scrolling (a collection of which is by the way, available in a listing from T. Woods). It is quite good.

;0C29 This is the beginning of the offset table. All of the BASIC command addresses are located in this table. If you relocate (permanently) a given BASIC command, then just put the starting address in the slot designated for the command that you change. That is precisely what we have done with LPRINT. The address 03D7 corresponds to the new routine address. We take over before any flags have been set or variables changed, AND more importantly, we

```

1400 CD1011 DIM CALL L0VA
1401 D29A00 DCEB JP NZ CERR
1402 CDA600 CALL AL37
1412 3008 JP NZ DRUN
1414 CBB1 RES 8,C
1416 CDA711 CALL STVA
1418 CD1000 CALL CSEV
1419 3808 DRUN JP C DLTR
141E 05 PUSH BC
141F CDF209 CALL NXBV
1420 CD600A CALL MMCL
1425 01 POP BC
1426 CBF9 DLTR SET 7,C
1428 0600 LD B,00
142A 05 PUSH BC
142B 210100 LD HL,0001
142E CBF1 BIT 0,C
1430 2002 JP NZ DNUM
1432 2E05 LD I,05
1434 E6 DE HL DNUM
1435 E7 RST 00H DMLO
1436 26BB DM48 LD H,BB
1438 CDDD12 CALL INSC
143B DA3112 JP C 3ERR

```

;1436 This is one of those oversight routines that is useless. Sinclair must have thought that no one would ever use the ZX81 with more than 16K. He put an arbitrary limit on the size of a single array at 16K. I changed this LD H,40 to LD H,BB, but it may as well been FF. You can't make an array larger than memory available anyway. Other routines watch out for this error. This routine could be eliminated and something else put in that is more useful. There is at least 8 bytes here.

```

16B8 3E10 ISTR LD A,10
16BA D7 RST 10H
16BB 10F8 DJNZ ISTR
16BD 1809 JP PRTH
16BF 3E10 IEXP LD A,10
16C1 D7 RST 10H
16C2 35 TINT DEC HL
16C3 34 INC HL
16C4 E8 RET PE
16C6 3E1B LD A,1B
16C7 D7 RST 10H
16C8 35 PRTH DEC HL
16C9 34 INC HL
16CA E8 RET PE
16CB CDD018 CALL PDGT
16CD 10F8 JP PRTH
16CE 7E PDGT LD A,(HL)
16CF E80F AND 0F
16D0 CDEB07 CALL PRCD
16D1 00 DEC HL
16D2 00 RET
16D3 7E PRCD LD A,(HL)

```

;16BB This oversight originally jumped back only to 16BA and printed whatever was in A (garbage). This change was originally reported in Syntax, and this change has been incorporated in the 1500 ROM.

For more information on the Sinclair ROM, I suggest purchasing Ian Logan's ZX81 ROM Disassembly part A and B. For easy study, enjoyment and other Sinclair related pleasures, I suggest purchase of Hot Z II (although I still prefer Hot Z I) and get the ROM name file. This listing is done with this name file in memory and as you can see, it makes it quite easy to see what is going on (especially with a hardcopy listing and explanation in front of you). It is available from Tom Woods.

```

18AB 20 ADD HL,HL
18AC 00 MAX
18AD 006A BDC HL,HL
18AF 09 MAX
18B0 0010 JP C NCPE
18B2 0002 BDC HL,HL
18B4 09 MAX
18B6 0002 BDC HL,HL
18B8 0007 JP NC 0010
18BA 0000 BDC AL,HL
18BC 09 MAX
18BE 0005 BDC AL,HL
18BF 09 MAX
18C0 0000 AND 0
18C2 0000 OR 0
18C4 0000 BDC HL,HL
18C6 0000 BDC HL,HL
18C8 0000 BDC HL,HL
18CA 0000 BDC HL,HL
18CC 0000 BDC HL,HL
18CE 0000 BDC HL,HL
18CF 0000 BDC HL,HL
18D0 0000 BDC HL,HL
18D2 0000 BDC HL,HL
18D4 0000 BDC HL,HL
18D6 0000 BDC HL,HL
18D8 0000 BDC HL,HL
18DA 0000 BDC HL,HL
18DC 0000 BDC HL,HL
18DE 0000 BDC HL,HL
18E0 0000 BDC HL,HL
18E2 0000 BDC HL,HL
18E4 0000 BDC HL,HL
18E6 0000 BDC HL,HL
18E8 0000 BDC HL,HL
18EA 0000 BDC HL,HL
18EC 0000 BDC HL,HL
18EE 0000 BDC HL,HL
18F0 0000 BDC HL,HL
18F2 0000 BDC HL,HL
18F4 0000 BDC HL,HL
18F6 0000 BDC HL,HL
18F8 0000 BDC HL,HL
18FA 0000 BDC HL,HL
18FC 0000 BDC HL,HL
18FE 0000 BDC HL,HL
1900 0000 BDC HL,HL
1902 0000 BDC HL,HL
1904 0000 BDC HL,HL
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TRY THIS. SHOW IT TO YOUR TS
FRIENDS.

QQQ VVV WWW UU OO KKK '''

ALSO TRY POKE 16389,255 ENTER

NEW

DIM A\$(45000)

LET A\$(45000)=1

PRINT A\$(45000)

YOU ARE READY FOR A BIG ZX/PRO-
FILE NOW

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1E-6

1E-7

1E-8

1E-9

10 LPRINT ,,,, "TRY THIS. SHOW
IT TO YOUR TS FRIENDS."

12 SLOW

14 LPRINT "QQQ VVV WWW UU OO
KKK ,,,, ", "ALSO TRY POKE 16389
,255 ENTER NEW", "DIM A\$(45000
)"

15 LPRINT "LET A\$(45000)=1 ",
"PRINT A\$(45000)"

16 LPRINT "YOU ARE READY FOR A
BIG ZX/PRO- FILE NOW"

19 LET X=10

20 FOR I=1 TO 10

30 LET X=X/10

40 PRINT X

50 LPRINT X

60 NEXT I

69 PRINT " INPUT ANY KEY"

70 PAUSE 4E4

80 CLS

90 FOR J=1 TO 10

100 FOR I=1 TO 22

110 PRINT "XXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXX"

120 NEXT I

130 FOR I=1 TO 22

140 SCROLL

150 PRINT "Y"

160 NEXT I

170 CLS

180 NEXT J

200 LLIST 10

10 LET X=TAN (PI/4)-1

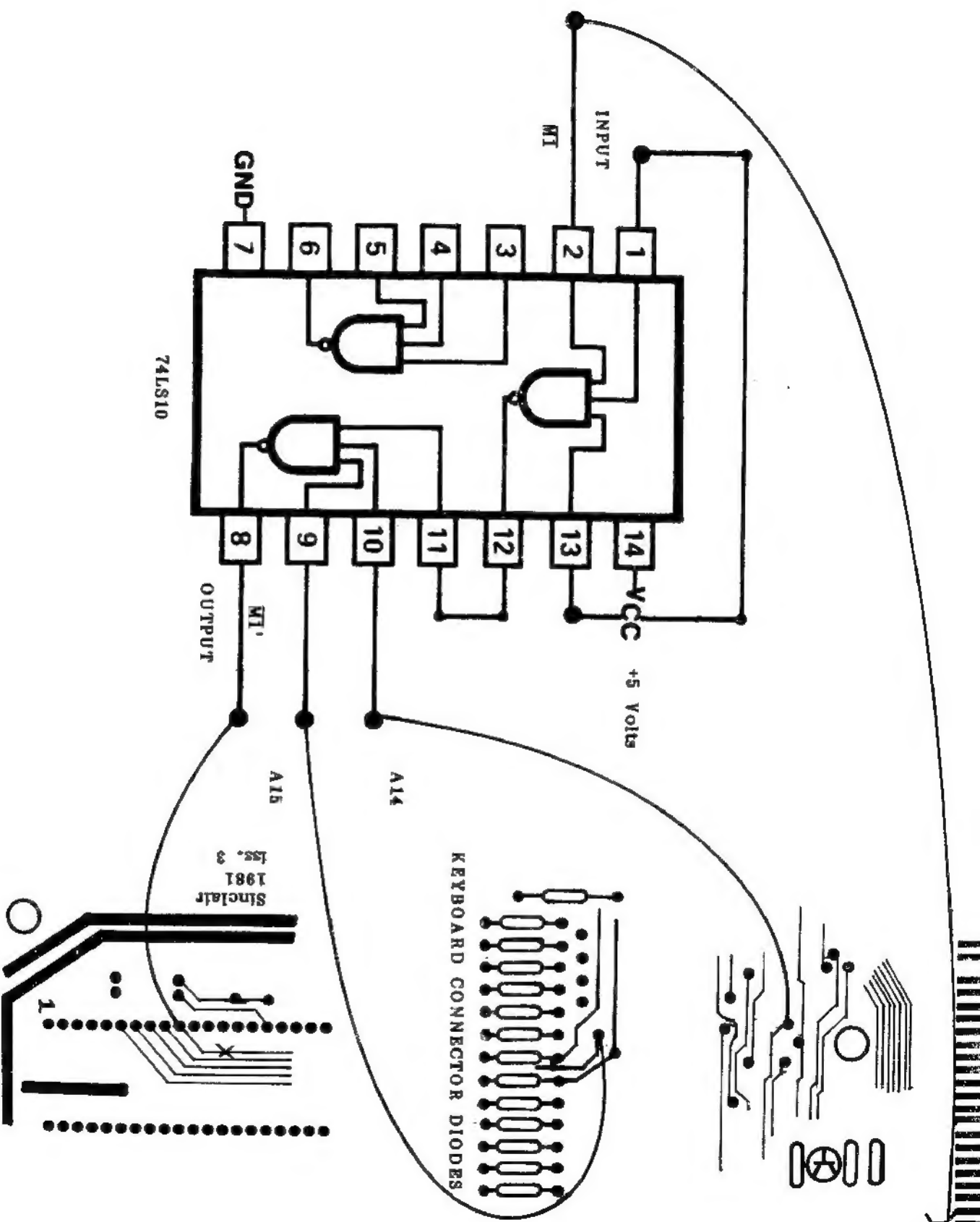
30 FOR I=1 TO 1000

40 LET X=X+X

60 NEXT I

70 PRINT X

90 PRINT I



UNDERSIDE of ULA CHIP

TS1000 32 to 48K Machine Code Modification